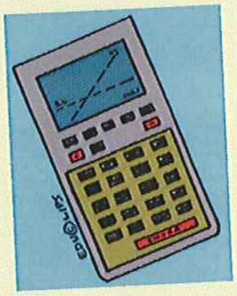
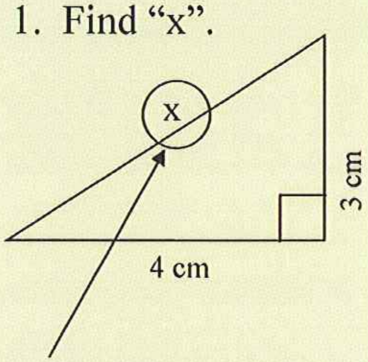
BASIC MATH REVIEW

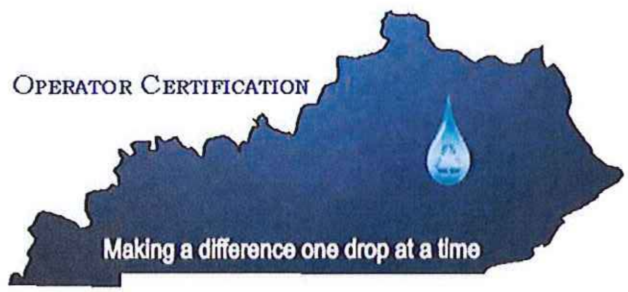


Kentucky
Water Treatment and Distribution System Operators

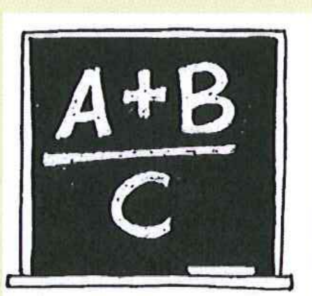
1. Find “x”.



Here it is.



COMMONWEALTH OF KENTUCKY
ENERGY AND ENVIRONMENT CABINET
DIVISION OF COMPLIANCE ASSISTANCE
CERTIFICATION AND LICENSING BRANCH
OPERATOR CERTIFICATION PROGRAM



Kentucky Board of Certification of
Water Treatment and Distribution System Operators

certifying **Professionals**

Table of Contents

Areas & Volumes

Terms

Area of Rectangle	=	length x width
Area of Triangle	=	1/2 base x height
Area of Circle	=	πr^2 or $\frac{\pi D^2}{4}$ or πR^2
Circumference of Circle	=	πD or $2\pi R$
Area of Cylinder	=	πDh
Volume of Cone, ft^3	=	1/3 base area x height
Volume of Rectangle, ft^3	=	length x width x height
Volume of Cylinder, ft^3	=	$\pi r^2 h$
Volume of Pyramid, ft^3	=	1/3 base area x height

in	=	inch
ft	=	foot
yd	=	yard
sec	=	second
hr	=	hour
MGD	=	million gallons per day
gal	=	gallon
lb or #	=	pound
mg/l	=	milligrams per liter
ppm	=	parts per million
in^2	=	square inches
in^3	=	cubic inches
ft^2	=	square feet
ft^3	=	cubic feet
cfs	=	cubic feet per second
fps	=	feet per second
gpm	=	gallons per minute
HP	=	horsepower
psi	=	pounds per square inch
gph	=	gallons per hour
Q	=	Flow (mgd, gpm, gph, cfs, etc.)
π	=	3.14

Equivalents

1 gallon (water)	=	8.34 pounds
1 cubic foot water	=	7.48 gallons (sewage)
1 cubic foot water	=	8.34 x 7.48 = 62.4 pounds
1 inch	=	2.54 centimeters
1 inch	=	0.0833 feet
1 cubic foot	=	1,728 cubic inches
1 cubic yard	=	27 cubic feet
1 pound	=	453.6 grams
1 cubic centimeter	=	1 gram = 1 milliliter
1 MGD	=	1.547 cfs or 694 gpm
1 CFS	=	646,317 gallons/day = 449 gpm
1 gal	=	3.785 liters
1 mg/l	=	1 ppm = 8.34 pounds per millions gallon
1 foot head (water)	=	0.433 psi
1 psi	=	2.31 ft of water
1 meter	=	100 centimeters = 1,000 millimeters = 3.281 ft
1 milliliter	=	20 drops (approximately)
1 acre	=	43,560 square feet
1 acre foot	=	326,000 gallons
1 million gallons	=	3.07 acre feet
1 horsepower	=	0.746 kilowatts = 550 ft lbs/sec = 3,960 ft gal/min
1 mile	=	5,280 feet = 1,760 yards

Formulas

1. (ppm)(8.34)(MGD)/0.17	=	Population Equivalent, BOD
2. (ppm)(8.34)(MGD)/0.20	=	Population Equivalent, Suspended Solids
3. ppm, suspended solids	=	(After sample weight) – Before sample weight)/(Difference)(1,000)(Sample Factor)
4. ppm, BOD	=	Initial DO – Average of Incubated Samples – BCF = (Oxygen used)(Dilution Factor)
5. Detention time in hours	=	(Capacity of tank in gallons)(24)/Daily flow in gallons
6. Pounds formula	=	Mg/l x 8.34 x MGD = Pounds
7. Efficiency	=	$\frac{\text{IN} - \text{OUT}}{\text{IN}} \times 100$
8. SVI	=	$\frac{SSV_{30}\text{ (Settled Sludge Volume)}}{\text{MLSS}} \times 1000$
9. Velocity of flow in ft/sec	=	$\frac{\text{Distance in ft}}{\text{Time in sec}}$

Fractions & Percentages

Fractions

Fractions are used to express a portion of one. They are usually expressed as:

- $1 \div 4$, or $\frac{1}{4}$ Where 1 is called the numerator and 4 is called the denominator.

If the numerator and denominator are the same, the result is 1.

Whole numbers are really fractions except the 1 is not usually shown.

- $8 = \frac{8}{1}$ $\qquad$ $4 = \frac{4}{1}$

In order to use fractions in calculations, we convert the fractions into decimal. To do this, we divide the numerator by the denominator.

- $\frac{1}{3}$ = 1 divided by 3 = .333

When multiplying fractions, multiply the numerators together and the denominators together.

- $\frac{1}{3} \times \frac{4}{5} = \frac{1 \times 4}{3 \times 5} = \frac{4}{15}$

When dividing by a fraction, you invert it and multiply it with the numerator.

- $\frac{2}{½} = \qquad 2 \times \frac{2}{1} = 4$

When simplifying fractions, the same number or unit must be in the denominator and numerator. These numbers are cancelled out because a number divided by itself is 1.

- $\frac{20}{4} = \frac{4 \times 5}{4} = 5$

Percentages

I order to use a percentage number in any equation; we must get the percentage (%) number into a whole or decimal number. To do this, we divide any number that has a percentage sign (%) behind it, by 100.

- $30.0\% = \frac{30}{100} = .30$ (Notice that the decimal point moved two places to the left.)

To convert a decimal to a percent, we multiply by 100% (or move the decimal point two places to the right.)

- $.55 = .55 \times 100\% = 55\%$

When solving the question “what percentage is one number of another”, use the following terms:

- of means x (multiply)
- is means = (equal)
- “What is 40% of 500?”
- What is (=) .4 of (x) 500
- .4 x 500 = 200

Fractions & Percentages: *Practice Problems*

1. Change 45% into a decimal.

2. Change 12% into a decimal.

3. What is 80% of 45?

4. What is 4% of 90?

5. What is 7% of 340?

6. What is 4/5 of 50?

7. Divide 4/5 by 5/4.

8. Simplify $\frac{ft^3/sec}{ft/sec}$

Ratio & Proportion

A proportion is a statement that two rations (or fractions) are equal.

- Example: 2:5::4:10

This is expressed as: Two is to five as four is to ten.

When we write this as fractions we have:

- $\frac{2}{5} = \frac{4}{10}$

If we cross multiply this, we have proven the proportion (or proven the fractions are equal).

- $\frac{2}{5} \quad \frac{4}{10}$
- $2 \times 10 = 4 \times 5$
- $20 = 20$

If we can set up a proportion with one of the numbers missing (or unknown) we can then solve by cross multiplication.

- Example: If twelve bolts cost you \$1.58, what will six bolts cost?

Set up as a proportion	12:1.58::6:?
Change to a fraction	$\frac{12}{\$1.58} = \frac{6}{?}$
Cross multiply	$12 \times ? = 6 \times 1.58$
Divide both sides by 12	$\frac{12 \times ?}{12} = \frac{6 \times 1.58}{12}$
Solve for ?	$? = \frac{6 \times 1.58}{12}$
	? = \$.79
	Six bolts = 79¢

This example is very simple because we know 6 is just ½ of 12 so we would take ½ of 1.58 and have the answer. But if we were figuring in other numbers it could be more difficult.

- Example: We know twelve bolts would cost \$1.58. How much would 126 bolts cost?

12:1.58::126:X	(use X as the unknown)
Change to fraction	$\frac{12}{\$1.58} = \frac{126}{X}$
Cross multiply	$12 \times X = 126 \times 1.58$
Divide both sides by 12	$\frac{12 \times X}{12} = \frac{126 \times 1.58}{12}$
Solve for X	$X = \frac{126 \times 1.58}{12}$
	$X = \$16.59$

Now we can set up proportions and solve for the unknown.

Ratio & Proportion: *Practice Problems*

1. 81:x::45:10

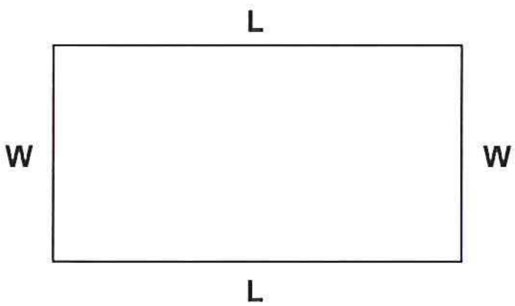
2. x:7::350:50

3. We have \$100.00 to spend on polymer and it costs \$1.50 for 10 lbs. How many pounds of polymer can we buy?

Water/Wastewater Geometry

Perimeter

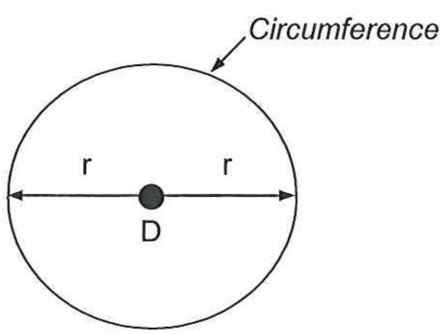
A measurement expressed as a length – feet, inches, yards.



(L (ft) x 2) + (W (ft) x 2) = Perimeter, ft

Example:

- 25' Width & 50' Length
- (50' x 2) + (25' x 2) = ft
- (100') + (50') = 150'
- Perimeter = 150'



2 x π x r(ft) = Perimeter, ft

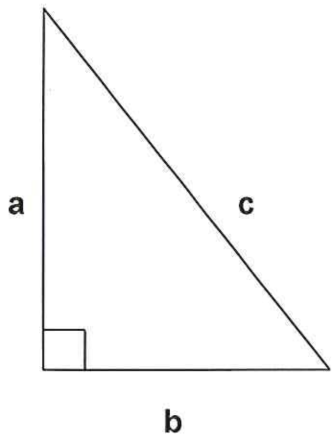
or

π x D(ft) = ft

Example:

- 100' Diameter
- π x 100' = ft
- 314' = Perimeter

- 50' Radius
- 2 π x 50
- 314' = Perimeter



$P = a + b + c$

If you were two of the three lengths, you can solve for the other using this formula:

$a^2 + b^2 = c^2$

$c = \sqrt{a^2 + b^2}$

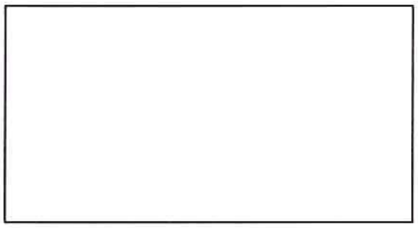
Example:

- $a = 10'$ & $b = 5'$
- $c = \sqrt{10^2 + 5^2}$
- $c = \sqrt{125}$
- $c = 11.2$ feet

- Perimeter $= a + b + c$
  $= 10' + 5' + 11'$
  $= 26$ ft

Areas

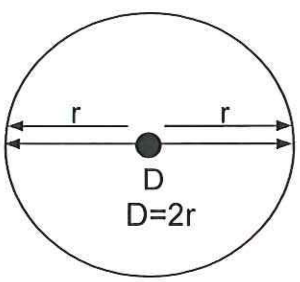
A flat measurement is recorded in square feet.



Length (ft) x Width (ft) = Area, ft^2

Example:

- 25' Width & 50' Length
- 50' x 25' = ft^2
- 1250 ft^2 = Area



π x $Radius^2$ (ft) = ft^2

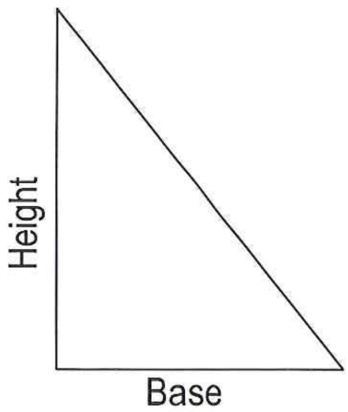
or

$\pi \times \left(\frac{D}{2}\right)^2 = ft^2$

Example:

- 15' Radius
- $\pi \times 15^2 = ft^2$
- 706.5 ft^2 = Area

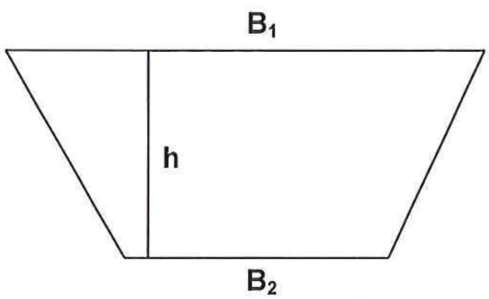
- 30' Diameter
- $.785 \times (30)^2 = ft^2$
- 706.5 ft^2 = Area



$$\frac{\text{Base (ft)} \times \text{Height (ft)}}{2} = \text{Area, ft}^2$$

Example:

- 10' Base & 20' Height
- $\frac{10' \times 20'}{2} = \text{ft}^2$
- $\frac{200'}{2} = \text{ft}^2$
- 100 ft^2 = Area



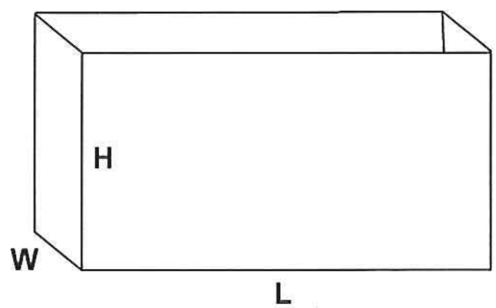
$$\frac{B_1\text{(ft)} + B_2\text{(ft)}}{2} \times \text{h (ft)} = \text{Area, ft}^2$$

Example:

- 50' B_1, 30' B_2 & 50' h
- $\frac{50' + 30'}{2} \times 20' = \text{ft}^2$
- $\frac{80' \times 20'}{2} = \text{ft}^2$
- $40' \times 20' = \text{ft}^2$
- 800 ft^2 = Area

Volumes

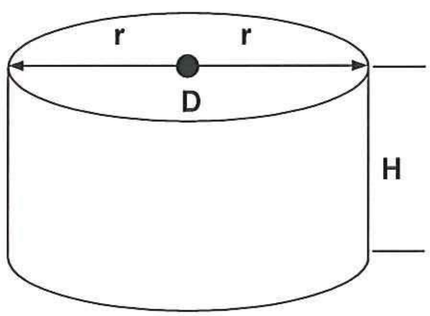
A three dimensional measurement recorded in cubic feet.



Length (ft) x Width (ft) x Height (ft) = Volume, ft^3

Example:

- 70' Length, 50' Width & 40' Height
- 70' x 50' x 40' = ft^3
- 140,000 ft^3 = Volume



π x $Radius^2$ (ft) x Height (ft) = Volume, ft^3

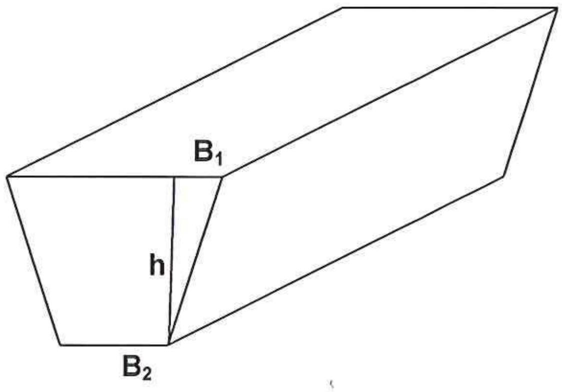
or

$.785\ D^2 \times h$

Example:

- 15' Radius & 25' Height
- $\pi \times 15^2 \times 25 = ft^3$
- $\pi \times 225 \times 25 = ft^3$
- 17,662.5 ft^3 = Area

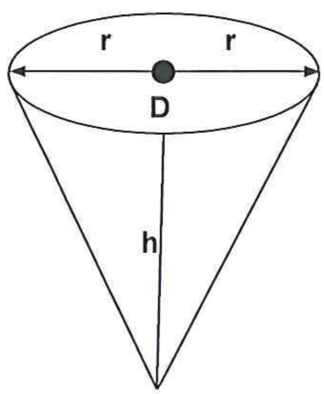
- 30' Diameter & 25'
- $.785(30)^2 \times 25$
- 17,662.5 ft^3 = Volume



$\frac{B_1 + B_2}{2}$ (ft) x Height (ft) = Volume, ft^3

Example:

- 20' B_1, 10' B_2, 25' Height & 50' Length
- $\frac{20' + 10'}{2}$ x 25' x 50' = ft^3
- $\frac{30'}{2}$ x 25' x 50' = ft^3
- 15' x 25' x 50' = ft^3
- 18,750 ft^3 = Volume



$1/3\ \pi\ \times\ r^2$ (ft) x h =Volume, ft^3

or

$1/3 \times .785\ D^2 \times h$

Example:

- 15' Radius & 25' Height
- $1/3\pi \times 15^2 \times 25$ = ft^3
- 1.05 x 225 x 25 = ft^3
- 5906.25 ft^3 = Volume

- 30' Diameter & 25' Height
- $1/3 \times .785(30)^2 \times 25$
- 5906.25 ft^3 = Volume

Ratio & Proportion: *Practice Problems*

1. Find the volume in ft^3 of a tank 40 feet x 10 feet x 120 feet.

2. Calculate the surface area of a rectangular clarifier 80 feet long and 35 feet wide.

3. What is the circumference in feet of a tank 90 feet in diameter?

4. A trench 3 feet wide, 8 feet deep, and 70 feet long is to be filled with sand.

   a. How many cubic feet of sand are required?

   b. How many cubic yards of sand?

   c. How many 5 cubic yard dump truck loads?

5. Calculate the surface area of a circular tank is 120 feet in diameter.

6. How many cubic yards of AC paving material will be required to pave over a trench 2400 feet long and 3 feet wide using a 3 inch deep patch?

7. If a sewer trench is 2 feet wide at the bottom, 12 feet deep, and the walls are sloped at 1 vertical to ¾ horizontal, how wide is the trench at the ground surface?

8. How many cubic feet of water will be held in a 250-foot line with a 4" diameter?

9. 1000 feet of 6" line holds how many cubic feet of water?

10. A circular tank of radius of 50 feet is filled to a depth of 10 feet with water. How many cubic feet of water have been added to the tank?

Units & Conversions (Dimensional Analysis)

Dimensional analysis is a tool that you can use to determine whether you have set up a problem correctly. In checking a math setup using dimensional analysis, you would only with the dimensions or units of measure and not with the numbers themselves. To use the dimensional analysis method, you must know three things:

- How to express a horizontal fraction (such as gal/cu ft) as a vertical fraction (such as $\frac{\text{gal}}{\text{cu ft}}$),
- How to divide by a fraction, and
- How to divide out or cancel terms in the numerator and denominator of a fraction.

These techniques are reviewed briefly below.

When you are using dimensional analysis to check a problem, it is often desirable to write any horizontal fractions as vertical fractions, thus:

$$\frac{\text{cu ft}}{\text{min}} = \text{cu ft/min}$$

$$\frac{\text{sec}}{\text{min}} = \text{sec/min}$$

$$\frac{\text{gal}}{\text{min}} = \text{gal/min}$$

Once the fractions in a problem, if any, have been rewritten in the vertical form, then terms can be divided out or cancelled. In cancelling terms, for every term cancelled in the numerator of a fraction, a similar term must be cancelled in the denominator, and vice versa as shown below:

$$\frac{\text{gal}}{\text{min}} \times \frac{\text{cu ft}}{\text{gal}} = \frac{\text{cu ft}}{\text{min}}$$

$$\frac{\text{lb}}{\text{day}} \times \frac{\text{day}}{\text{min}} = \frac{\text{lb}}{\text{min}}$$

$$\text{sq in} \times \frac{\text{sq ft}}{\text{sq in}} = \text{sq ft}$$

$$\frac{\text{cu ft}}{\text{sec}} \times \frac{\text{gal}}{\text{cu ft}} \times \frac{\text{sec}}{\text{min}} \times \frac{\text{min}}{\text{day}} = \frac{\text{gal}}{\text{day}}$$

Suppose you wish to convert 1200 ft^3 volume to gallons, and suppose that you know you will use 7.48 gal/ft^3 in the conversion, but that you don't know whether to multiply or divide by 7.48. Let's look at both possible ways and see how dimensional analysis can be used to choose the correct way. Only the dimensions will be used to determine if the math setup is correct.

First, try multiplying the dimensions:

$$(ft^3)(gal/ft^3) \quad = \quad (ft^3) \quad \frac{(gal)}{(ft^3)}$$

Or re-expressed as

$$= \quad \frac{(ft^3)(gal)}{(ft^3)}$$

Then multiply the numerators and denominators.

$$= \quad \frac{(ft^3)(gal)}{ft^3}$$

And cancel common terms:

$$= \quad \frac{\cancel{(ft^3)}(gal)}{\cancel{ft^3}}$$

$$= \quad gal$$

So, by dimensional analysis you know that if you *multiply* the two dimensions (cu ft and gal/cu ft), the answer you get will be in *gal*, which is what you want. Therefore, since the math setup is correct you would then multiply the numbers to obtain gal:

(1200 cu ft)(7.48 gal/cu ft) = 8976 gal

If we had divided the dimensions:

$$\frac{ft^3}{gal/ft^3}$$

Remember when dividing fractions, take the denominator and invert it, then multiply it with the numerator.

$$\frac{ft^3}{gal/ft^3} = ft^3 \times \frac{ft^3}{gal} = \frac{ft^3}{gal}$$

Which is not the answer we want, so we know we cannot divide.

Units and Conversions: *Practice Problems*

Make the following conversions without the aid of a conversion table:

1. Define the following:

   a. gpm

   b. cfs

   c. MGD

   d. mg/l

2. 1 ft^3 of water contains ____________ gallons.

3. 1 ft^3 of water weights ____________ pounds.

4. 1 gallon of water weights ____________ pounds.

5. One cubic foot per second is equivalent to ____________ gpm.

Make the following conversions:

6. 7000 ft^3 to gallons

7. 20 cfs to gpm

8. 450 gpm to MGD

9. How many feet of water will produce 45 psi?

10. 4.7 cfs to gal/min.

11. 6,800,000 ft^3 to MG

12. 0.045 MGD to gal/min

13. 100,000 ft_3/min to MGD

14. 3920 lbs of water to ft_3

15. 36 ft of head to psi

16. If there are 10 grams of solids in 25 gallons of water, what is the concentration in mg/l?

17. Using dimensional analysis, convert 120 gpm into ft_3/min.

18. Using dimensional analysis, convert 85 ft_3/min to MGD.

19. Using dimensional analysis, convert 69 cfs to gpd.

20. Convert 65 ft^3/min to gpm.

21. Convert 39 gpd to ft^3/min.

22. Convert 78 ft^3/min to MGD.

23. Convert 2 MGD to gpd.

Temperature

Formula's used to convert Farenheit (°F) with Celcuis (°C) are:

$$°C = \frac{5}{9}(°F - 32)$$

$$°F = \frac{9}{5}(°C) + 32$$

Unless you use them frequently, they are hard to remember.

The following is an easier method to use. With this method, you only need to determine whether to multiply by 9/5 or 5/9. Since °C is less then °F, then multiply by 5/9 to go from °F to °C as it makes the number smaller.

$$°F \times \frac{5}{9} \longrightarrow °C \qquad\qquad °C \times \frac{9}{5} \longrightarrow °F$$

The method is as follows:

Step1) Add 40 to the given temperature
Step 2) Multiply by 5/9 or 9/5 depending on the conversion
Step 3) Subtract 40 =
ANSWER

Example: Convert 68 °F to °C

1) Add 40

   $68 + 40 = 108°$

2) Multiply by 5/9 to lower the number

   $\frac{5}{9} \times 108 = 60$

3) Subtract 40

   $60 - 40 = 20°C$

Example: Convert -40°C to °F

1) Add 40

   $-40 + 40 = 0$

2) Multiply by 9/5

   $\frac{9}{5} \times 0 = 0$

4) Subtract 40

   $0 - 40 = -40$

Good trivia question! $-40\,^{\circ}C = -40\,^{\circ}F$

Practice Problems

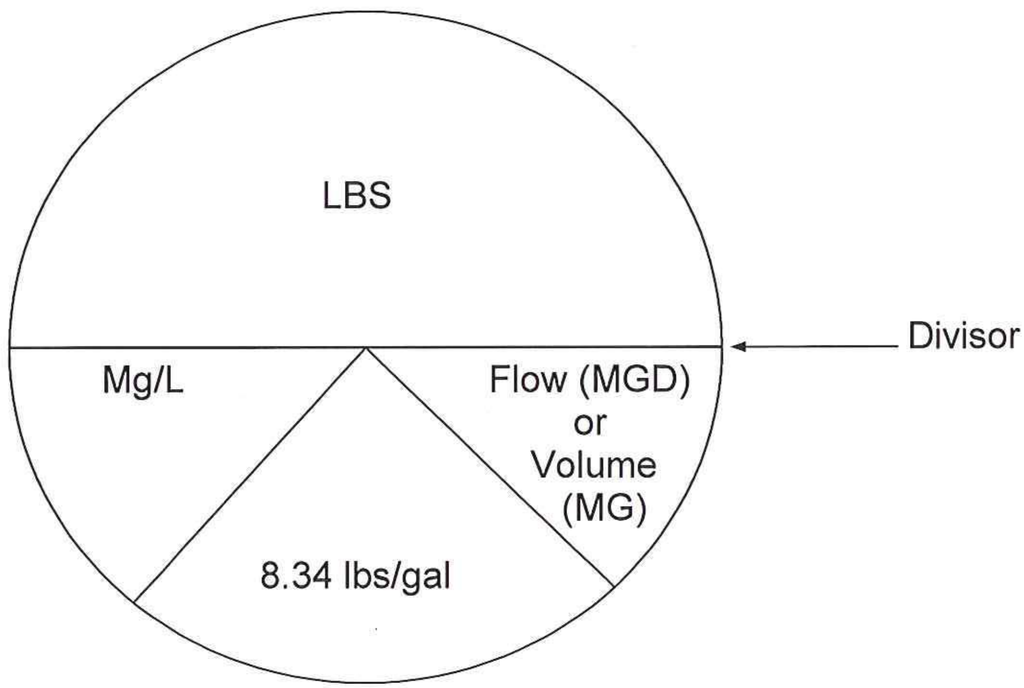
1. Convert 35°C to °F.

2. Convert 10°C to °F.

3. Convert 115°F to °C.

Pounds

The Pounds Formula

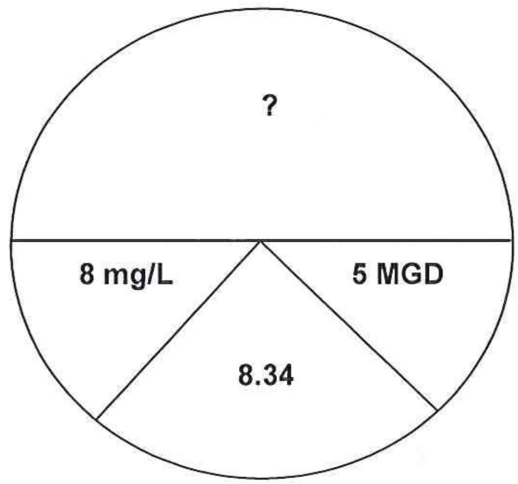


Mg/L x 8.34 x MGD = Pounds

Example:

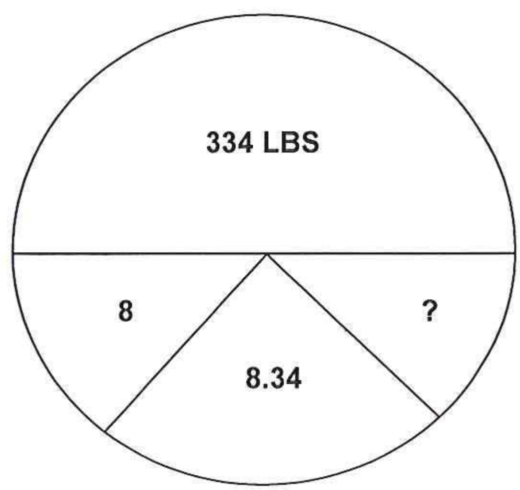
The chlorine dosage is 8 mg/L/ If the daily flow is 5 MGD, how many pounds of chlorine are being added?

8 x 8.34 x 5 = 334 LBS

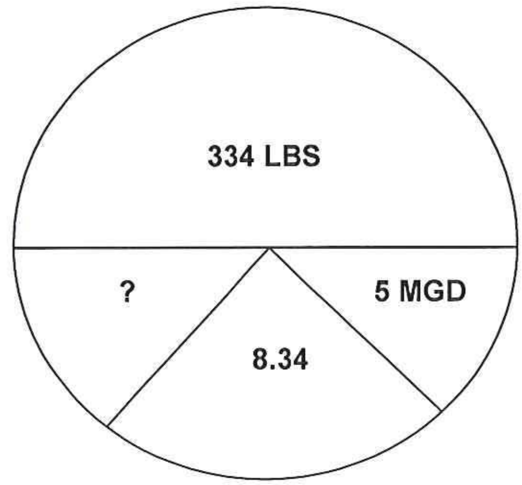


What is the flow?

334 divided by 8 and divided by 8.34 = 5 MGD

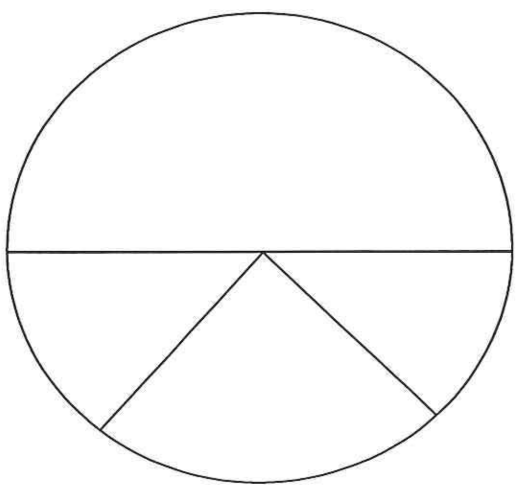


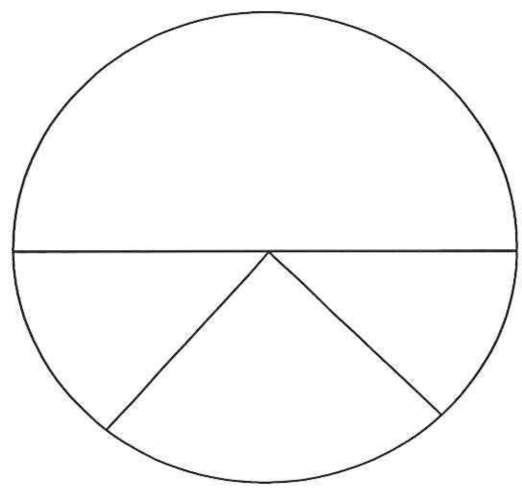
What is the dosage in mg/L?



334 divided by 5 and divided by 8.34 = 8 mg/L

Try these problems:





The chlorine dosage is 4 mg/L.
The daily flow is 6 MGD.
How many pounds are used for the day?

A treatment plant uses 120 LBS of alum per day.
The flow is 1.8 MGD.
What is the alum dosage in mg/L?

Pounds: *Practice Problems*

1. The influent suspended solids to a WTP is 50 mg/L. The flow is 5 MGD. How many pounds SS are entering the plant?

2. What is the chlorine feed rate to disinfect a flow of 750,000 gallons with a chlorine dose of 6 mg/L?

3. The Cl_2 dosage for a treatment plant is 4 mg/L. The flow is 6.2 MGD. How many pounds of chlorine are being fed?

4. The Cl_2 residual is 0.8 mg/L. For the same flow of 6.2 MGD, how many pounds of chlorine are in the water entering the distribution system? Based in question #3, what is the chlorine demand in pounds?

5. Jar test indicates that the alum dose should be 8 mg/L. If the flow is 1.75 MGD, what is the desired alum feed rate in lbs/day? lbs/hour?

6. A storage tank is to be disinfected with a 50 mg/L dosage. If the tank volume is 70,000 gallons, how many pounds of chlorine are needed?

7. For question #6, if a 15% hypochlorite solution is used, how many gallons are needed?

8. The required chlorine dosage is 10 mg/L to disinfect 800,000 gals/day. If a 65% hypochlorite solution is used, how many gallons will be required?

9. What would the chlorine concentration in mg/L be if the flow was 6 MGD and 300 lbs/day was used?

10. A reservoir holds 3 MG of water. For algae control 0.5 mg/L of copper will be required. How many pounds of copper will be needed? If 25% copper sulfate is used, how many pounds of copper sulfate will be needed?

11. The chlorine feed rate is 15 lbs/day. If the flow is 250,000 gpd, what is the dosage in mg/L.

Flow & Velocity

Q = AV is used to estimate flowrates through channels, pipes (flowing full) and tanks. Usually, the units used are:

Q	=	flowrate, cfs		cfm
A	=	Area, ft^2	or	ft^2
V	=	Velocity in fps		fpm

Other units can be used but the units on one side of the equation must equal the units on the other side of the equation.

This formula can be rearranged to solve for either flowrate, velocity or area.

<u>Flows & Velocity: *Practice Problems*</u>

1. If a channel is 2 feet wide, 1 foot deep, 15 feet long and it takes 20 seconds for the water to travel from one end of the channel to the other, what is the velocity of the water?

2. A 15-inch diameter pipe is flowing full and carrying a flow of 2.7 MGD. The water velocity (average) should be

   a. 3.4 ft/sec

   b. 5.5 ft/sec

   c. 13.6 ft/sec

   d. 25.4 ft/sec

   e. 54.4 ft/sec

3. What is the velocity in fps when the flow is 18 cfs in a 24-inch pipe?

4. What is the flowage through a channel 4 ft wide flowing to a 2.5 foot depth at a velocity of 1.5 fps?

5. The flow at a treatment plant is .25 MGD. How large would a wet well be to fill in 60 minutes (in cubic feel and gallons)?

6. Water is drawn from a 60-ffot I.D. storage tank. The operator forgets to turn off the valve until the level in the tank has dropped 10 feet. How many gallons of water has been removed?

7. What is the flowrate in gpm in a 24-inch pipe moving at a velocity of 3 fps?

8. Flow through a pipe is 1.5 cfs. If the velocity is 2 fps and the pipe is flowing full, what is the pipe diameter in inches?

9. A piston pump making 35 strokes per minute delivers 800 gpm. If the strokes are reduces to 20, what is the discharge rate?

Detention Time

Definition

The time required for a given flow of wastewater to pass through a tank, which is equal to the time it takes to fill the tank at a given flow rate.

$$\text{Detention Time} = \frac{\text{Volume, gal}}{\text{Flow Rate, gal/time}}$$

Detention time is expressed as a unit of time such as seconds, minutes, hours, days, etc.

Detention time is a concept used as a design consideration in nearly every treatment unit in a treatment system and is a mathematical method of checking the performance of existing facilities against design values.

The formula can be rearranged to solve for volume, flowrate or detention time.

<u>Detention Times: *Practice Problems*</u>

1. What is the detention time in hours of a tank 80' L x 30' W x 10' deep receiving flow of 4.0 mgd?

2. How many minutes does it take to fill a 10' diameter circular tank 10' high at a flowrate of 10 gpm? How many hours?

3. A pump with an output of 75 gpm can empty a tank in 5 hours. How many gallons have been pumped?

4. How long will it take (minutes and hours) to pump out a circular tank containing 100,000 gallons with a pump discharging 33 gpm?

Answer Key

Fractions/Percentages (p 5)

1	.45
2	.12
3	36
4	3.6
5	23.8
6	16
7	.64 or 16/25
8	ft^2

Ratios/Proportions (p 8)

1	18
2	49
3	666.67

Geometry (p 15-16)

1	48000 ft^3
2	2800 ft^2
3	282.6 ft
4a	1680 ft^3
4b	62.2 yd^3
4c	12.44 (or 13 loads)
5	113.4 ft^2
6	66.7 yd^3
7	20 ft
8	21.8 ft^3
9	196.8 ft^3
10	78500 ft^3

Units/Conversions (p 20-23)

1a	gallons per minute
1b	cubic feet per second
1c	million gal. per day
1d	milligrams per liter
2	7.48
3	62.4
4	8.34
5	448.8
6	52360 gal
7	8976 gpm
8	.648 MGD
9	104 ft of head
10	2109.4 gpm
11	50.864 MG
12	31.25 gpm
13	1075.3 MGD
14	62.8 ft^3
15	15.6 psi
16	105.7 mg/L
17	16 ft^3/min
18	.91 MGD
19	44,592,768 gal/day
20	486.2 gpm
21	.0036 ft^3/min
22	.839 MGD
23	2,000,000 gal/day

Flow/Velocity (p 34-35)

1	.75 ft/sec
2	3.4 ft/sec
3	5.7 ft/sec
4	15 ft^3/sec
5	10417 gal / 1393 ft^3
6	211,385 gal
7	4227.7 gpm
8	11.7 in
9	457 gpm

Temperatures (p 26)

1	95 F
2	50 F
3	46.1 C

Pounds (p 30-31)

1	2085 lbs
2	37.5 lbs
3	206.8 lbs
4	41.4 lbs/165.5 lbs
5	116.76 lbs/day 4.87 lb/hr
6	29.2 lbs
7	23.3 gal
8	12.3 gal
9	6 mg/L
10	(12.5 lb Cu)(50.4 lb $CuSo_4$)
11	7.19 mg/L

Detention Time (p 37-28)

1	1.08 hr
2	587 min / 9.8 hrs
3	22500 gal
4	3030 min / 50.5 hrs

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Kentucky811

Why do utilities, excavators, contractors and the public have to call Kentucky811 prior to disturbing the earth?

The Kentucky Dig Law (KRS 367.4901 to KRS 367.4917) has been in affect since 1994. The law requires all persons excavating to call at least two full business days before digging, and no more than 10 business days prior to digging. The act in its entirety can be viewed at the following Web site: www.kentucky811.org.

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